

THE SURGICAL TREATMENT OF PERFORATION OF THE INTESTINES IN TYPHOID FEVER.¹

A REVIEW OF THE LITERATURE.

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THE importance of perforation of the intestine in typhoid fever can be best indicated by a brief review of the prevalence of typhoid fever in general, and the report of 369 cases of perforation of the intestine gathered from literature since the classical paper by Harte and Ashhurst,² in which they record 362 cases, with 268 deaths, an operative mortality of 74.03 per cent.

FREQUENCY OF TYPHOID FEVER. The reports of the United States Census Bureau show that in the "Registration Area" for the years 1901 to 1905 inclusive, there was an average per year of 10,458 deaths from typhoid fever, or a mortality rate of 32.2 per 100,000 of population. In 1906 this jumped to 13,160 deaths, the increase being due, in part, to an enlargement in the size of the registration area and also to a higher mortality of the disease in that year. The mortality of typhoid fever in this country is only exceeded by that in Finland, Ceylon, Servia, Australia, Spain, and Italy. In the registration area the highest death rate is found in Pennsylvania, with a mortality rate of 56.5 per 100,000 of population.³ To all these figures the city of Philadelphia has contributed more than one would expect, for from January 1, 1903, to September 15, 1908, there have occurred 32,218 cases, with 4930 deaths.⁴

FREQUENCY OF PERFORATION. Vaughan⁵ states that the frequency of perforation has been variously estimated at from 1.3 to 2 per cent. Of necessity, the statistics vary in different epidemics of the disease. Edsall⁶ has observed that hemorrhage and perforation have a tendency to occur in groups in hospital practice, and he believes it to be a question whether or not complications or severe abdominal symptoms are not due to some secondary infection rather than to the typhoid infection itself. I have collected 21,215 cases of typhoid fever from literature; perforation occurred in 671, a frequency of 3.16 per cent.

ETIOLOGY OF PERFORATION. The causes of perforation may be classified as predisposing and exciting. Among the former is sex,

¹ Read in abstract at the meeting of the Philadelphia County Medical Society, October 28, 1908.

² *Annals of Surgery*, January, 1904.

³ Report of the Commissioner of Health, Pennsylvania, 1905-1906.

⁴ Personal communication from the Director of the Department of Health and Charities, Philadelphia.

⁵ *Washington Medical Annals*, March, 1906.

⁶ *AMER. JOUR. MED. SCI.*, April, 1908.

with the greatest frequency in males. My analysis comprises 281 males and 58 females; in 30 cases the sex is not stated. This preponderance of the male sex is of necessity an incidence of their greater liability to the disease. So, too, age is a factor, the larger number of cases occurring before the age of thirty years. In this analysis 249 cases were under thirty-one; in 75 cases the age was over thirty-one; and in 45 cases it was not stated. Kisberg⁷ quotes Henoch, Baginsky, Morse, and others as stating that perforation is rare in children, a statement which, as Elsberg has shown, is not substantiated by a study of the reported cases. Elsberg notes 25 cases, and I have collected 68 additional cases, all of which were subjected to operation. That children stand operative interference better than adults is well shown by the fact that of these 68 cases only 31 died, a mortality rate of 45.58 per cent. Intestinal parasites may be either a predisposing or exciting cause, or both. Tympany may be a factor in the production of perforation; as Curschmann⁸ points out, when excessive it causes paralysis of the muscular layer of the intestine and consequent immobility.

The exciting causes of perforation are, as a rule, mechanical, and anything that causes a sudden or unusual stimulation of peristalsis must be regarded as a possible etiological factor.

TIME OF PERFORATION. While statistics show that more than 70 per cent. of the cases of perforation occur between the second and fifth week of the disease (in 413 out of a series of 568 cases it occurred during that time), still it should be remembered that perforation may occur at any time during the course of the disease, in a relapse, or even in convalescence. In Goodall's⁹ series of 96 cases, in 9.3 per cent. the perforation took place during a relapse. Briddon¹⁰ has noted a perforation occurring on the twelfth day of convalescence, and Panton¹¹ another on the twenty-seventh day. Pluyette and Allezars¹² report a case of typical typhoid perforation of the ileum occurring two months after the cessation of the fever and unaccompanied by any symptoms of a relapse. So, too, perforation may occur in the ambulatory case as well as in the one in which the severity of the symptoms is marked, but more commonly it occurs in the latter.

PATHOLOGY. The pathology of the intestinal lesions of typhoid fever is so well known that it seems unnecessary again to consider it in detail, save to emphasize the fact that the lesions are, as a rule, situated on the free border of the intestine opposite the mesenteric attachment; thus, at a point where the blood supply is relatively poor, and which in itself predisposes to necrosis and subsequent perforation. As Maylard¹³ has stated, the tendency of the typhoid

⁷ *Annals of Surgery*, July, 1903.

⁸ *Nothnagel's Encyclopedia*, American edition, 1907.

⁹ *Lancet*, 1904, ii, 9.

¹⁰ *Ibid.*, 1897, xxvi, 219.

¹¹ *Annals of Surgery*, 1896, xxiii, 198.

¹² *Marseille méd.*, 1904, xli, 321.

¹³ *Surgery of the Alimentary Canal*, London, 1900, p. 247.

ulcer is to perforate in contradistinction to the ulceration of tuberculosis. It is rare that perforation takes place into the mesentery with the formation of a retroperitoneal abscess; most common is perforation into the general peritoneal cavity. Numerous observers have called attention to the fact that there is but slight tendency to the formation of adhesions and consequent localized abscess; a few such cases have been observed by Da Costa,¹⁴ Holmes,¹⁵ and others.

ANATOMICAL LOCATION. While the ileum is the most common seat of the perforation, no portion of the gastro-intestinal tract, except the duodenum, is apparently exempt.

Stomach. Mauger¹⁶ quotes Milliard as reporting 2 cases and Louis 1 case of perforation of this viscus. Basile¹⁷ reports the case of a woman, age not stated, on whom at operation he found the perforation of a typical typhoidal ulceration of the posterior surface of the stomach. Mazetti¹⁸ states that at autopsy on a patient who died of typhoid fever, he found a perforation of the posterior wall of the stomach near the pylorus.

Jejunum. Beros¹⁹ reports 2 cases: 1 discovered at operation and the other at autopsy.

Ileum. In my study of 369 cases the ileum was the seat of perforation in 279, or in 75.60 per cent. of the cases.

Meckel's Diverticulum. Mauger notes the cases reported by Golton, Dreyfus, Delanglade, and also a personal communication from Heurteaux reporting the successful operation in a boy aged ten years. Long²⁰ also notes another successful case in a man aged twenty-five years. Goodall observed one case postmortem and Landis²¹ another similar case.

Cecum. Mauger notes the 8 cases reported by Leudet (3 cases), Rokitansky (2 cases), Milliard, Thompson, Herbert and Thurston. In my statistics are included 5 subsequent cases reported by: Bousset,²² male, aged twenty-two years; operation, death; Claybrook,²³ male, aged eight years, operation, recovery; Fontoyne,²⁴ male, aged twenty-two years, operation, death; Scott,²⁵ female, aged twenty-two years, operation, recovery; Haggard,²⁶ male, aged twenty-three years, operation, death.

The Vermiform Appendix. The limitation of the space at my disposal does not permit of a detailed consideration of the appendi-

¹⁴ Personal communication.

¹⁵ Jour. Amer. Med. Assoc., March 14, 1903.

¹⁶ La perforation typhique de l'intestin et de ses annexes, son traitement chirurgical. Thèse de Paris, 1900.

¹⁷ Il Policlin., 1905, tome xx, ses Prat., p. 157.

¹⁸ La Riforma med., 1908, xxiv, 487.

¹⁹ Contributions a l'étude des perforations intestinales chez les typhiques. Thèse de Bordeaux, 1906-1907.

²⁰ Surgery, Gynecology, and Obstetrics, 1907, iv, 301.

²¹ Personal communication.

²² Bull. méd., 1905, xix, 109.

²³ Personal communication.

²⁴ Bull. et mém. soc. de chir. de Paris, 1908, xxxiv, 701.

²⁵ Personal communication.

²⁶ Personal communication.

ceal complications of typhoid fever, which have been admirably described by Deaver,²⁷ Francois,²⁸ Frazier and Thomas,²⁹ Hopfenhausen,³⁰ Rolleston,³¹ and others. Briefly stated, it may be said that the appendix during typhoid fever may be the seat of any possible grade of inflammation, and that this may terminate in resolution or in the surgical calamities of perforation or pus formation. Deaver collected 40 cases of perforation, of which 7 were operated upon, with 4 deaths; the remaining 33 all died. I have collected 15 additional cases, all of which were operated upon, with 5 deaths—a mortality of 33.33 per cent. Deaver notes 41 cases of inflammation, of which 30 were subjected to operation, with 4 deaths; of the 10 cases not operated upon, 9 died. I have collected 22 additional cases, all of which were operated upon, with 4 deaths—a mortality of 18.18 per cent. In practically all of the inflammatory cases that recovered the operation was performed early in the disease. I agree with Deaver that during the height of the disease it is best not to operate, unless there is good evidence of perforation or pus formation.

Colon. Prevost-Maisonnay³² reports 2 cases, and in my analysis are included 12 subsequent cases.

Rectum. Mauger states that Leudet and Hutinel have each reported cases in which the rectum was the seat of a perforation. In 57 cases the anatomical location of the perforation was not stated.

SIZE AND NUMBER OF PERFORATIONS. The size of the hole in the intestine may vary from that of a pin point to that of a fifty cent piece, or larger. As a rule there is only one perforation, but there may be more. Scott³³ reports a case in which there were five, and in my study the perforations were multiple in 31 of the cases. As Selby³⁴ has emphasized, the leakage of the intestinal contents is of necessity in direct proportion to the size of the perforation.

SYMPTOMS. The symptoms of perforation should be divided into two classes: those occurring immediately at the time of perforation, and those later symptoms which are the result of it, or, in other words, those of the succeeding general peritonitis.

The symptoms of actual perforation may be either abrupt or gradual in their onset, and in a certain small number of the cases all leading symptoms are conspicuous by their absence. More commonly the onset is abrupt, and McPhedran³⁵ has observed that

²⁷ Appendicitis, etc., Philadelphia, 1905.

²⁸ L'appendicite au cours de la fièvre typhoïde, Paris, 1904.

²⁹ Univ. Penn. Med. Bull., July-August, 1907.

³⁰ Rev. med. de la suisse romande, 1899, xix, 105.

³¹ Lancet, May 29, 1898.

³² Lesions du colon dans la fièvre typhoïde, Thèse de Paris, 1899.

³³ Univ. Penn. Med. Bull., 1905, xviii, 81.

³⁴ AMER. JOUR. MED. SCI., 1908, cxxxv, 224.

³⁵ Canada Lancet, March, 1907.

the symptoms of perforation vary according to the situation which the perforated bowel occupies in the abdominal cavity—the nearer it lies to the centre of the abdomen the more fulminating will be the local and constitutional symptoms. It should be remembered that there is no pathognomonic symptom of perforation.

Martin³⁶ and McCrae³⁷ have each noted that while more or less abdominal pain may be present in the course of typhoid fever, the onset of sudden abdominal pain is a symptom of perforation of the first importance. As Manges³⁸ aptly states: "It is the constancy of the early occurrence of pain which makes it so important as a symptom of perforation." This pain varies in intensity and location; it is usually more or less localized to the lower right quadrant of the abdomen, or it may be referred to the umbilicus. As a rule it is a constant pain, becoming more intense at intervals. Pain that is localized at first but later becomes general throughout the abdomen, is an indication of a progressive general peritonitis. In cases of severe infection the apathetic, delirious, or comatose condition of the patient may entirely mask this subjective symptom, which, however, is prominent in fully three-quarters of the cases.

What has been described as the sudden classical fall of temperature in the light of our further knowledge, seems to be the exception rather than the rule. Scott states that a sudden rise of 1° or 2° followed by a slow but persistent fall to normal or subnormal over a period of eight to ten hours is more common, but in some few cases there is no appreciable change. The pulse rate usually rises rapidly; one of 140 beats per minute is not uncommon within twenty minutes after the time of perforation.

The two physical signs of the utmost importance that are usually present are tenderness and rigidity. The tenderness may be most marked at the point of pain, and this is accompanied by rigidity, usually more marked on the right than the left side in the beginning; with the onset of general peritonitis it is found in all the abdominal muscles.

So, too, the facial expression undergoes a change difficult of description; it is what the French have appropriately termed an "abattement," or weakening of the countenance, which, with the onset of general peritonitis, is replaced by the facies so characteristic of that disease.

Percussion of the abdomen may or may not aid in the diagnosis, for the normal liver dulness may have been obliterated previously by reason of intestinal distention. Manges, with an experience of 19 cases, states as his belief that it may be a sign of value if care be taken to watch daily any alteration in it.

³⁶ De la douleur abdominale dans la fièvre typhoïde, Thèse de Paris, 1901.

³⁷ New York Med. Jour., May 4, 1901.

³⁸ Jour. Amer. Med. Assoc., April 1, 1905.

The knowledge to be gained by an examination of the blood is as yet still a disputed point, save that as, Shattuck, Warren, and Cobb³⁹ have emphasized, an isolated count is valueless. Thayer⁴⁰ first showed the hypoleukocytosis of this disease, and Scott quotes Kast and Gutig, and Le Conte and Lewis as having drawn attention to the fact that in typhoid fever the onset of complications is not characterized by a leukocytosis. Differential counts have been believed by some to be an aid, but the whole question still remains to be settled. A rise in the blood pressure has been thought by Crile⁴¹ to be an indication of perforation, and from a study of 5 cases he concludes that there is a rise in the pressure after perforation to the same high level as occurs in peritonitis from other causes—a view that is shared by Sheppard,⁴² Rochester,⁴³ and others.

The symptoms of general peritonitis, the result of the perforation of a typhoid ulcer, are in no way different from those of a general peritonitis of different etiology. Their onset is usually to be observed in from four to six hours after the time of perforation, and presents a clinical picture so well known as to need no description here.

DIAGNOSIS. The ideal would be to make the diagnosis in what Cushing⁴⁴ calls the "pre-perforative stage," but this period in the fulminant cases may be so short as to pass unnoticed as a clinical entity. It may be further obscured by the fact, as Killiani⁴⁵ has shown, that the perforation may involve other viscera, such as the gall-bladder, simultaneously with the intestine. Then, too, perforation may be simulated by other conditions: Miller⁴⁶ notes 2 cases of fecal impaction in children which gave the symptoms of an intra-abdominal calamity; Hall,⁴⁷ a case in which perforation was simulated after the administration of a medicinal dose of opium; Scudler,⁴⁸ a series of cases of mistaken diagnoses.

The space at my disposal does not permit of the consideration in detail of the differential diagnosis of perforation from hemorrhage, cholecystitis, suppurating mesenteric gland, and iliac or femoral thrombosis. While every effort should be made to make a correct diagnosis, too much emphasis cannot be laid upon the fact that all important is the recognition of the fact that some intra-abdominal calamity has occurred that demands immediate operative interference for its relief. Occasionally cases of perforation may recover without an operation; Miller⁴⁹ has noted such a case in which the perfo-

³⁹ Trans. Assoc. of Amer. Phys., 1900, xv, 82.

⁴⁰ Johns Hopkins Hospital Reports, 1894-1895, p. 83.

⁴¹ Jour. Amer. Med. Assoc., 1903, xl, 1292.

⁴² Lancet, 1907, i, 1293.

⁴³ Annals of Surgery, 1901, xxxiii, 544.

⁴⁴ Archiv. of Pediat., 1906, xxiii, 441.

⁴⁵ Jour. Amer. Med. Assoc., December 8, 1906.

⁴⁶ Boston Med. and Surg. Jour., July 18, 1907.

⁴⁷ Personal communication.

⁴⁸ Ibid., 1907, xlv, 38.

⁴⁹ Ibid., May 25, 1899.

ration became sealed by an adherent tag of omentum; Brown,⁵⁰ another similar case; Musser,⁵¹ a case in which a perforation of the ileum was closed by adhesion to the posterior wall of the bladder. Price⁵² states as his belief that the reports of recovery from perforation without operation are entirely too numerous to be true.

PROGNOSIS. The prognosis of necessity bears a distinct relation to the rapidity with which the diagnosis is made and operation performed, and to the bacteriology of the resulting peritonitis. As a general rule this is due to the colon bacillus, more rarely to the typhoid bacillus or to virulent organisms such as the streptococci. Vincent,⁵³ Flexner and Fraenkel,⁵⁴ Dalziel,⁵⁵ and others have all emphasized the fact that the streptococcal infections of the peritoneum are practically always fatal.

TREATMENT. An immediate operation should be the rule in all cases of perforation, unless the subject is dying. Occasionally patients have recovered that have been operated upon some time after the occurrence of the perforation: thus, Lauper⁵⁶ notes one on which he operated successfully fifty-eight hours after the perforation, and Moschowitz⁵⁷ another successful case, which came to operation three and one-half days after the apparent time of perforation.

As regards the anesthetic, there is a choice between local and general anesthesia. Local anesthesia has been used with success in some cases, but the use of ether would seem to be preferable, as it tends to diminish shock. It is all important that the operation should be speedily performed.

The more generally employed incision is that through the outer half of the right rectus muscle. As soon as the peritoneal cavity is opened a methodical search should be made for the perforation. The ileum should first be found and examined, as that is the most common location of the lesion.

The hole in the intestine may be treated either by suture, enterostomy, or resection. When closure can be accomplished without too great narrowing of the lumen of the bowel, Lembert sutures, preferably of silk, may be employed. It is a needless waste of time to excise the ulcer. In those cases in which the closure by suture is not practicable, enterostomy is indicated; the subsequent closure of the artificial anus is usually safely accomplished. This method was first proposed by Escher,⁵⁸ and has since been strongly advo-

⁵⁰ *Annals of Surgery*, March, 1903.

⁵¹ *Pennsylvania Medical Journal*, April, 1905.

⁵² *American Journal of Obstetrics*, 1907, lvi, 691.

⁵³ *Anal. de l'Institut Pasteur*, vii, 141.

⁵⁴ *Johns Hopkins Hospital Reports*, 1895.

⁵⁵ *Glasgow Medical Journal*, 1905, lxiiv, 262.

⁵⁶ *Corbl. f. Schw. Aertze*, 1905, xxv, 74.

⁵⁷ *New York Med. Monat.*, 1904, xvi, 402.

⁵⁸ *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1903, xi, 4.

cated by Bartlett,⁵⁹ Hays,⁶⁰ and others. Anderson⁶¹ states that the toxemia from a paralyzed bowel is a big factor in the mortality of perforation cases, and that this is an indication for a drainage rather than a suture operation, a view that has been concurred in by Domela.⁶² The objection to the operation of resection is its great mortality. The peritoneal cavity should be flushed out with quantities of either hot salt solution or sterile water, and the operation completed by the introduction of drainage. Scott,⁶³ Blake,⁶⁴ and others, while insisting on the value of the Murphy method of enteroclysis, are opposed to the use of the Fowler position, as in their experience it has seemed to be productive of distinct harm. On the other hand, Hays,⁶⁵ who has had a large experience and very great success with his cases, states that he invariably employs it in an exaggerated form, the patient being placed almost upright in bed.

CONCLUSIONS. Too much stress cannot be laid upon the fact that all important is an early diagnosis and immediate operation. This would seem to be best attained by a close coöperation between physicians and surgeons, so that the latter, when the complication occurs, may not be at the disadvantage of not having seen the patient before. While typhoid fever in the past has been regarded as a disease belonging essentially to the realm of internal medicine, in the light of our further knowledge one may state that its relation to surgery is indeed most intimate. Holscher⁶⁶ studied the results of autopsies upon 2000 cases of typhoid fever and found that only 24 per cent. died from the fever per se, and the remaining 76 per cent. died as the result of the various sequels. Flexner⁶⁷ notes that in 80 per cent. of the cases of typhoid fever the bacillus can be shown in the blood of the patient during life; Busquet⁶⁸ has recently reported a series of 43 cases in which he noted it in the blood in pure culture.

That typhoid fever patients stand surgical interference well has been admirably illustrated by the case reported by Cushing, in which the patient was operated upon three times within two weeks: twice for perforation and once for intestinal obstruction from adhesions, and yet recovered. Scott⁶⁹ reports the case of a boy, aged eight years, who at operation presented two perforations of the ileum and a gangrenous and perforated appendix and still made a good recovery despite three relapses.

⁵⁹ International Journal of Surgery, 1904, xvii, 99.

⁶⁰ Personal communication.

⁶¹ American Medicine, December 31, 1904.

⁶² Rev. de gynéc. et de chir. abdom., 1905, ix, 623.

⁶³ International Clinics, viii, 21.

⁶⁴ New York Medical Journal, February 23, 1907.

⁶⁵ Personal communication.

⁶⁶ Münch. med. Woch., 1891, xxxviii, 43.

⁶⁷ Journal of Pathology and Bacteriology, 1894, iii, 202.

⁶⁸ La presse méd., 1902, p. 593.

⁶⁹ University of Pennsylvania Medical Bulletin, May-June, 1905.

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SUMMARY OF STATISTICS.

Number of operative cases	369
Died	242
Mortality percentage	65.58

Age.

Under thirty-one years	249
Over thirty-one years	75
Not stated	45

Total 369

Youngest patient aged five years; oldest, aged sixty-five years.

	Cured.	Died.	Mortality percentage.
Children	37	31	45.58
Adults	75	178	70.03
Not stated	15	33	68.77
Total	127	242	65.53

Sex.

Males	281
Females	58
Not stated	30
Total	369

Location of the Perforation.

Stomach	1
Jejunum	1
Meckel's diverticulum	2
Ileum	279
Cecum	5
Appendix	15
Colon	12
Not stated	54
Total	369

Perforation of the Appendix.

Sex.

Males	9
Females	5
Not stated	1
Total	15

Results of Operation; Perforation of the Appendix.

	Cured.	Died.	Mortality percentage.
Adults	6	3	33.33
Children	4	0	..
Not stated	0	2	100.00
Total	10	5	33.33

Number of cases with multiple perforations	31
Greatest number in a single case	5

Treatment of Perforation.

	Cured.	Died.	Mortality percentage.
Suture	108	223	70.38
Enterostomy	9	11	55.00
Resection	0	3	100.00
Appendectomy	10	5	33.33
Total	127	242	65.58

Cases of Inflammation of the Appendix Submitted to Operation.

	Cured.	Died.	Mortality percentage.
Adults	10	3	23.07
Children	4	1	20.00
Not stated	4	0	00.00
Total	18	4	18.18

**SPASM OF THE CHEST MUSCLES, PARTICULARLY THE
INTERCOSTALS, AS A PHYSICAL SIGN OF
DISEASE OF THE LUNGS.**

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MUSCLE rigidity has long been considered an important symptom in certain diseases, especially acute disease of the abdominal organs. This muscular spasm or rigidity varies in location according to the organ diseased; thus, if the appendix is inflamed, the rigidity is found in the right lower quadrant of the abdomen; if the gall bladder, in the right rectus; if gastric perforation or pancreatic disease be present, in the upper portion of the left rectus; and when general peritonitis is present, the abdominal muscles generally show rigidity. Spasm of the lumbar muscles is noticed in pyelonephritis, and spasm of muscles about the joints is an important symptom accompanying tuberculosis of the joints. So far, I have not been able to find mention of rigidity of the chest muscles as a sign of inflammation of the lungs. Musser¹ mentions the fact that spasm of the thoracic muscles occurs over the affected side in pleuritis, but does not mention its occurrence when the parenchyma of the lung is involved. Mackenzie² explains the sense of constriction experienced during attacks of angina pectoris as being due to spasm of the intercostal muscles through reflex stimulation.

In the examination of patients suffering from pulmonary tuberculosis, I have found this muscle rigidity, particularly as it affects the intercostal muscles, to be a constant sign. Not only have I been able to map out the areas of infection, but I have been able

¹ Medical Diagnosis.

² Diseases of the Heart.